WETLAND INVENTORY UPDATE
YEAR 4 SYNTHESIS REPORT
2008

February 18, 2009
Water Resources Division
Natural Resources Department
Lummi Indian Business Council

LUMMI NATION

WETLAND INVENTORY UPDATE
YEAR 4 SYNTHESIS REPORT
2008

Prepared for:

Lummi Indian Business Council
(LIBC)

Funded by:
U.S. Environmental Protection Agency
(Grant No. BG-97042602-2)

Prepared by:

Water Resources Division
Lummi Natural Resources Department

Primary Author:

Frank Lawrence III, LIBC Water Resources Planner I

Primary Contributors:

Gerry Gabrish, GIS Manager
Jeremy Freimund, P.H., Water Resources Manager

February 2009

This project has been funded wholly or in part by the United States Environmental Protection Agency under Assistance Agreement BG-97042602-2 to the Lummi Nation. The contents of this document do not necessarily reflect the views and policies of the Environmental Protection Agency, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

TABLE OF CONTENTS

1. BACKGROUND/INTRODUCTION 2

2. METHODS FOR WETLAND INVENTORY UPDATE 7

2.1 METHOD FOR WETLAND MAPPING/BOUNDARY DETERMINATION 7
2.2 METHOD FOR WETLAND FUNCTION ASSESSMENT 9
2.3 METHOD FOR WETLAND RATING/CLASSIFICATION 10
2.4 METHOD FOR UPDATING THE LUMMI NATION GIS WETLAND INVENTORY/DATABASE 11
2.5 METHOD FOR QUALITY ASSURANCE/QUALITY CONTROL 12

3. WETLAND INVENTORY UPDATE RESULTS 14

3.1 RESULTS OF WETLAND MAPPING AND BOUNDARY DETERMINATION 14
3.2 RESULTS OF FUNCTION ASSESSMENT 18
3.3 RESULTS OF WETLAND CLASSIFICATION 20

4. DISCUSSION 21

5. REFERENCES 24

Appendix A – Individual Wetland Maps
Appendix B – Sample of Function Assessment and Wetland Rating Worksheets
Appendix C – Quality Assurance/Quality Control Technical Memorandum
By ESA Adolfson

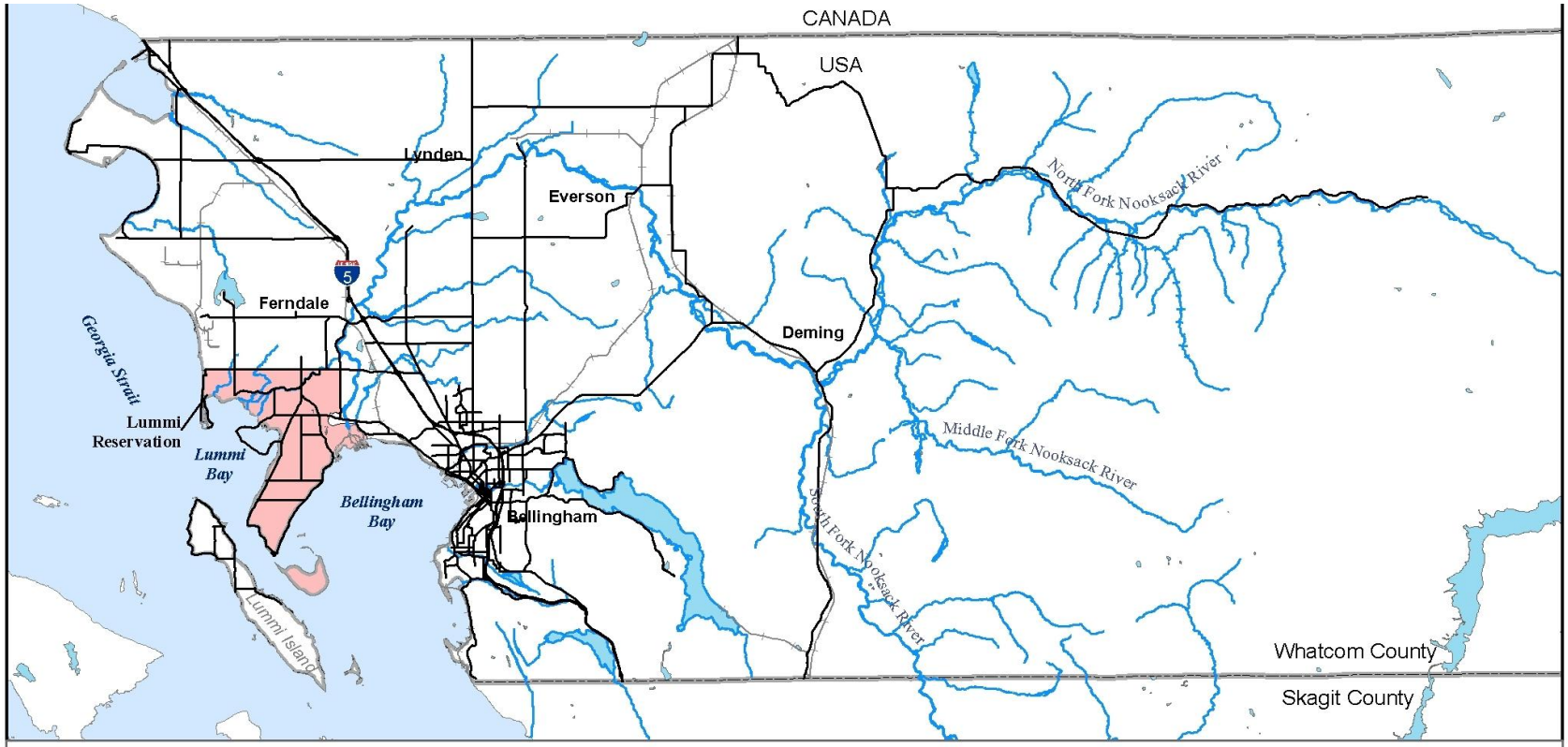
1. BACKGROUND/INTRODUCTION

The Lummi Indian Reservation (Reservation, see Figure 1) is located along the western boundary of Whatcom County, Washington and includes the mouth of the Nooksack and Lummi rivers. Both the Nooksack and Lummi river watersheds are under environmental pressures from rapid regional growth. The Lummi Nation has also entered a period of rapid economic development under self-governance. Growth on and near the Reservation requires that the Nation's core environmental program prioritize the development of a regulatory infrastructure that allows for responsible growth while protecting tribal resources and the Reservation environment. This regulatory infrastructure supports both the tribal goal and the Environmental Protection Agency (EPA) policy of tribal self-governance and recognition of sovereignty.

Previous EPA and other funding sources have supported the Lummi Nation's assessment of priority water resource needs and the identification of unmet needs. Environmental planning intended to protect the Nation's water resources has included development of a Storm Water Management Program (LWRD 1998a), a Wellhead Protection Program (LWRD 1997, LWRD 1998b), a Wetland Management Program (LWRD 2000), a Non-Point Source Management Program (LWRD 2001, LWRD 2002), and Water Quality Standards for Surface Waters of the Lummi Indian Reservation (LWRD 2008). These programs are components of a comprehensive water resources management program (CWRMP) being developed and implemented pursuant to Lummi Indian Business Council (LIBC) resolutions No. 90-88 and No. 92-43.

In January 2004, the Lummi Nation Water Resources Protection Code (Title 17 of the Lummi Code of Laws [LCL]) was adopted. Based on a Reservation-wide wetland inventory completed in 1999 (Harper 1999) and as described in Chapter 17.06 (Stream and Wetland Management) of the Code, different types of wetlands that vary in their quality and importance occur on the Reservation. In order to establish appropriate levels of protection, pursuant to LCL Chapter 17.06 the Reservation wetlands must be classified into one of four categories. Category 1 wetlands are considered critical value wetlands that have a high and irreplaceable level of importance for fisheries, Lummi culture, and/or water quality on the Reservation. Category 4 wetlands have minimum habitat value and are suitable for restoration or enhancement efforts.

The purpose of the 1999 Reservation-wide wetland inventory was to identify wetland locations and to collect information on the characteristics and functions of the Reservation wetlands. The 1999 Reservation-wide wetland inventory (Harper 1999) relied largely on remotely sensed data (i.e., color and infra-red aerial photographs), generalized mapping (i.e., USDA soil survey), and limited field verification to identify wetland locations and sizes. In addition to identification and mapping, the 1999 inventory collected general wetland information including Cowardin classification (Cowardin et al. 1979),



For this map and all other maps in this document, Lummi Nation GIS Department makes no claim as to the accuracy, completeness, or content of any data contained herein. Any user of this data assumes all responsibility for use thereof and further agrees to hold the Lummi Nation harmless from and against any damage, loss, or liability arising from any use of this data. This map is not intended to reflect the exterior or tideland boundaries of the Lummi Reservation. No part of this document may be reproduced without prior consent of the Lummi Nation.

Figure 1 - Regional Location of the Lummi Indian Reservation, Washington

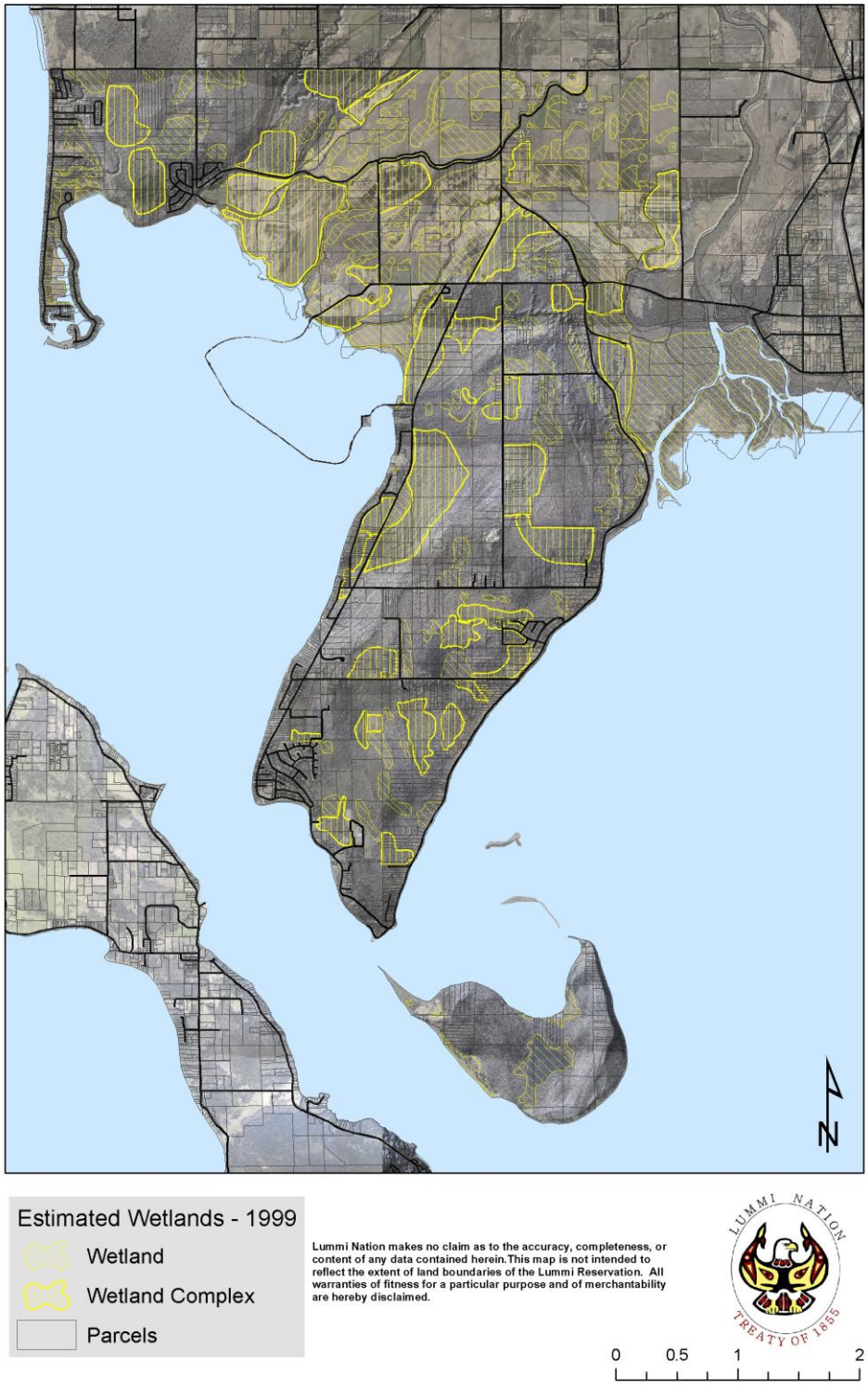
water source, and soil type. The Washington State Function Assessment Method was applied to twelve (12) assessment units (AUs) in nine (9) selected wetlands on the Reservation. The 1999 inventory identified and mapped a total of 214 wetlands and wetland complexes on the Reservation (Figure 2). These wetland areas totaled 5,432 acres, or roughly 43 percent of the land area of the Reservation, excluding tidelands. Approximately 60 percent of these mapped wetland areas are located in the flood plains of the Lummi and Nooksack rivers.

Although the 1999 inventory represents an important planning tool and a significant improvement over the previously available information, which was largely from the National Wetlands Inventory (USFWS 1987), the 1999 inventory has proven to be too general for many planning efforts. The 1999 inventory either did not map some wetlands or generally shows larger wetland areas than are surveyed in the field or identified using Global Positioning System (GPS) technology. Refining the spatial resolution of the wetland mapping, performing function assessments, and classifying the wetlands into the regulatory categories identified in Title 17 is intended to support efforts to protect these wetland resources and the important ecological, hydrological, and water quality protection functions that they provide. Because of the large number of wetland areas on the Reservation, the effort to refine the spatial resolution of the wetland mapping, to perform function assessments, and to classify the Reservation wetlands is projected to require several years to complete. This report summarizes the results of Year 4 of this inventory update effort.

As described in more detail below, a wetland consulting firm was contracted following Year 3 of the update effort to provide an independent program evaluation and quality assurance/quality control review. As a result of this evaluation and review, the function assessment element of the wetland inventory update effort was de-emphasized during Year 4. Function assessments were still conducted on certain wetlands, but the function assessment element was deferred for most wetlands until a development activity is imminent and the assessment is needed to determine appropriate mitigation measures for any unavoidable wetland impacts.

For the purposes of this inventory update, a wetland evaluation consists of conducting site visit(s), performing at least a detailed reconnaissance level delineation, using the GPS to map the identified wetland boundaries, and classifying the wetlands into one of four categories.

Figure 2 - 1999 Wetland Inventory Results



This approach to updating the Reservation-wide wetland inventory resulted in the evaluation of 14 wetlands during Year 4 (approximately 7 percent of the total number of wetlands identified during the 1999 inventory). One of the 14 evaluated wetland areas consists of two identified assessment units (AUs). When combined with the 36 wetlands identified during Year 1, 35 wetlands identified during Year 2, and the 20 wetlands identified during Year 3, a total of 105 wetlands (approximately 49 percent) of the Reservation wetlands have been evaluated.

Based on this experience and assuming the same evaluation methodology and rate, additional time will be required to complete an evaluation of all of the Reservation wetlands.

The relatively low number of wetlands that were evaluated during Year 4 is associated with a staffing change that occurred in November 2007. The staffing change was part of an effort to develop the capacity of an enrolled Lummi tribal member in wetland management. The staff transition included an investment in training and practical applications with various wetland scientists, which reduced the amount of time available to advance the wetland inventory update effort. Although the training and capacity building of the newer staff person continues, it is anticipated that the number of wetlands that will be evaluated during Year 5 of the effort will increase relative to Year 4.

This Year 4 wetland inventory update synthesis report is divided into the following sections:

- Section 1 is this background/introduction section.
- Section 2 describes the methods used to conduct the mapping and categorization of Reservation wetlands.
- Section 3 presents a summary of the results of Year 4 of the wetland inventory update.
- Section 4 provides a discussion of the Year 4 results.
- Section 5 lists the references cited in the report.

Appendix A contains a map of each wetland mapped during the fourth year of the inventory update. The results from Year 1, Year 2, and Year 3 are summarized in similar synthesis reports (LWRD 2005, LWRD 2006, LWRD 2007). The field notes and categorization worksheets for each wetland and function assessment are on file with the Lummi Water Resources Division. In Appendix B, an example of the field categorization and function assessment worksheets completed for each wetland is provided. Appendix C is a copy of the independent peer review report of the wetland inventory update program prepared by ESA Adolfson.

2. METHODS FOR WETLAND INVENTORY UPDATE

The methods used to update and refine the spatial resolution of the 1999 Inventory are described below. ESA Adolfson, Douglass Consulting, and the Lummi Water Resources Planner I collected field data for the results summarized in this update from October 2007 through September 2008.

Five inter-related methods were used to update and refine the 1999 inventory. The different methods were used for wetland mapping/boundary determination, for wetland function assessment, for wetland rating/classification, for updating the Lummi Nation GIS wetland inventory/database, and for quality assurance/quality control.

2.1 Method for Wetland Mapping/Boundary Determination

Because of property access issues and the remoteness and size of some of the Reservation wetlands, it was not practical to undertake a geography-based approach (i.e., watershed by watershed) to selecting the wetlands evaluated during this study. Instead, the locations of the wetlands evaluated during this inventory update were based on areas where property was considered for purchase by the LIBC, development actions were contemplated, and/or on parcels for which Lummi Land Use Permit Applications were submitted to the Lummi Planning Department. In several areas, small and moderate sized wetland areas were discovered that had not been identified in the 1999 inventory.

During the planning stages for this update effort, it was estimated that approximately 70 wetlands could be evaluated during one year (approximately three days per wetland). This estimate proved to be overly optimistic due to a number of factors including property access issues and the remoteness and size of some of the wetlands. There were also seasonal considerations including long periods of flooding, frozen ground, and snow that limited and/or prevented wetland boundary determination during portions of the winter season. During the summer season, mapping forested wetland areas is problematic because GPS satellite signals were often difficult to obtain through the dense tree canopy.

Of the 214 wetlands on the Reservation that were mapped during the 1999 inventory, 14 wetland areas were field verified and mapped during Year 4 of this update effort. Function assessments were conducted for six (6) of the fourteen (14) wetland areas. As previously mentioned, one of the evaluated wetland areas (38N1E01-05) has two assessment units (A and B). Ratings/classifications were performed on ten (10) of the fourteen (14) wetland areas during this inventory update effort (approximately 6 percent of the total number of inventoried wetlands). One of the wetland areas (38N1E01-05) had two ratings/classifications performed (AUs A and B). Pursuant to a contract between the Lummi Planning Department and Douglass Consulting, the consulting firm will complete the ratings/classifications and function assessments for the four

wetland areas that have not yet received completed documentation. Although the wetland ratings and function assessments have not been completed yet, the wetland boundaries were determined for each wetland as part of this update.

In several cases, development actions were planned on a parcel of land where the 1999 inventory indicated that large wetlands or wetland complexes were located over contiguous parcels. Because acquiring landowner permission is time consuming – particularly for undivided parcels in trust status that may have in excess of 100 landowners, in many cases only a portion of the wetland boundary on the particular parcel where the development action was planned was mapped. As a result, there are several wetlands and numerous fragments of wetlands that have been mapped by Lummi Water Resources Division staff during the last several years. These areas are mapped or partially mapped and appear in Figure 3, Figure 4, and Appendix A. Work is in progress on these areas, and function assessments and classification/ratings have not yet been performed due to time constraints, adverse weather, and/or other reasons. These areas have been archived in the Lummi Nation Geographic Information System (GIS) so that work can continue on these wetlands and mapping, function assessments, and categorization can be finalized in the future as this wetland inventory update is completed.

Once a wetland from the 1999 inventory or a land parcel was selected for evaluation, the methodology used to reliably identify and map the wetland boundaries was the following:

1. Prior to conducting a field visit, available remotely sensed data including high resolution aerial photography collected during 2004 (approximately 0.5 feet resolution) and high-resolution (approximately $\pm$0.5 feet accuracy) topographic information acquired in 2005 using Light Detection and Ranging (LIDAR) technology were reviewed. Maps developed as part of the USDA soil survey for the area (USDA 1992) were also reviewed.
2. Information developed during the 1999 wetland inventory, including watershed name and size, wetland size, Cowardin classes present, association with streams or other water resources, and USDA soil units in the vicinity was reviewed.
3. During the field visit(s), one of the following two methods for determining wetland boundaries were used:
    - If development activities were planned that would potentially impact wetlands, or a jurisdictional determination of the wetland boundary was required, the wetland boundary was determined in the field using the criteria and methodology of the Wetland Delineation Manual (Manual) issued by the U.S. Army Corps of Engineers (COE 1987). This manual requires examination of three parameters: vegetation, soils, and hydrology. For an area to be classified as a wetland, hydrophytic vegetation, hydric soils, and wetland hydrology must be exhibited. The specified criteria are mandatory and must all be present, except under circumstances when a wetland is considered a disturbed area or a

problem wetland. Once delineated, the wetland boundaries were recorded using a handheld Trimble GeoXT GPS unit, and downloaded into ArcMap9 GIS software. The horizontal accuracy of the Trimble GeoXT is ± 2 feet once the collected data are post-processed.

- If development activities were not planned, and or other conditions made locating the boundary difficult (i.e., lack of satellite configuration for the GPS unit, lack of permission to access property, or other reason), a "reconnaissance-level" boundary determination was made instead of a jurisdictional determination. Much more time would have been required if jurisdictional determinations were made on all the wetlands because wetland data plots along regularly spaced transects would have been required. For the reconnaissance-level of determination, the same criteria were applied, but in a less formal manner, or in some cases, only a portion of the wetland edge was recorded using a GPS unit, and the rest of the wetland boundary estimated using a combination of other methods (i.e., aerial photography and LIDAR). In some cases, portions of the wetland boundaries were recorded using a combination of an on-the-ground reconnaissance, GPS data, soil mapping, LIDAR data, and recent aerial photography.

2.2 Method for Wetland Function Assessment

Pursuant to the recommendations from the independent program evaluation/review (Appendix C), wetland function assessments are now being deferred until a development action is planned that will impact a wetland and a function assessment is required to determine appropriate mitigation for unavoidable wetland impacts. This program modification is anticipated to allow more of the Reservation wetlands to be visited during a year and to accelerate the completion of the inventory update.

When wetland function assessments are conducted on the Lummi Reservation, the *Methods for Assessing Wetland Functions, Volume 1* by the Washington State Wetland Function Assessment Project (Hruby et al. 1999) are used. The Washington Method (commonly called WAFAM) is based on the nationally recognized Hydrogeomorphic (HGM) approach (Brinson 1993), which classifies wetlands based on landscape position and water regime, and provides guidance on arriving at technical assumptions on which performance assessments of functions are based. The HGM method proposes the following classes of wetlands: Depressional, Fringe, Slope, Riverine, and Flats (Brinson 1993). The Washington State technical committee has thus far developed assessment methods only for depressional and riverine wetlands. Most of the wetlands on the Lummi Reservation fall into these two categories, although estuarine fringe and flats are also clearly present.

The Washington State approach (Hruby et al. 1999) relies on indicators of functions to assess potential performance, rather than direct measurements. Indicators are usually physical characteristics of the wetland or its surrounding area that can be correlated to a specific function. For example, rather than trying to directly sample aquatic mammals, the presence of steep banks in the wetland can be used as an indicator of the suitability of the wetland habitat for aquatic mammals. After collecting detailed data on indicators, mechanistic models (mathematical equations) are applied to the data to arrive at a numeric indexed score. This step is based on the assumption that the relationship between indicators and the actual performance level for a function can be defined by a simple mathematical expression. Different models were developed for each subclass of wetland and for each function category (Hruby et al. 1999).

The first step in assessing wetland functions is to divide the wetland into assessment units (AUs). Wetlands are divided into AUs based on differences in water regime. The AU boundary occurs where the volume, flow, or velocity of the water changes rapidly, whether created by natural or artificial features. An entire wetland may be uniform in its water regime and would therefore be comprised of a single AU.

As noted above, the WAFAM method relies on indicators of functions to assess potential performance rather than direct measurements. A total of fifteen (15) categories of functions are assessed for each wetland under the WAFAM method. The indices that result for each wetland function represent an assessment of performance relative to standard reference wetlands identified as having the highest level of performance within that wetland subclass.

The assigned function index reflects the level of performance per unit area of the wetland being assessed. Another calculation must be made to factor in the size of the assessment unit to get a final performance index for each function of a particular assessment unit. The index denotes the assessed potential performance or habitat suitability based on the structural characteristic present in and around the assessment unit. The index does not denote the actual performance, as that would require detailed monitoring. It is assumed that the assessment unit will perform the function if the appropriate structural components are present and if the opportunity exists. A low index (i.e., 1,2,3) for a function does not necessarily mean the wetland is “unimportant.” It may be the only wetland in the area providing certain functions.

2.3 Method for Wetland Rating/Classification

There is currently no tribal or federal rating system to categorize wetlands based on functions and values. As a result, the Washington State Department of Ecology’s *Wetland Rating System for Western Washington – Revised* (Hruby 2004) was used to classify Reservation wetlands. This document is a revision of the *Washington State Wetland Rating System for Western Washington,*

published by the Department of Ecology in (Ecology 1991). The 2004 version was used for all wetlands inventoried for this Year 4 effort.

The current version of the wetland classification system was designed to differentiate between wetlands based on their sensitivity to disturbance, their significance, their rarity, the ability to replace them, and the functions they provide. The classification system results in rating wetlands into one of the following four categories:

- Category 1 wetlands are those that represent a unique or rare wetland type, or are more sensitive to disturbance than most wetlands, or are relatively undisturbed and contain ecological attributes that are impossible to replace within a human lifetime, or provide a high level of functions (scores > 70 points).
- Category 2 wetlands are difficult, though not impossible to replace, and provide high levels of some functions (scores between 51 – 69 points). These wetlands occur more commonly than Category 1 wetlands, but still need a relatively high level of protection.
- Category 3 wetlands are wetlands with a moderate level of functions (scores between 30 – 50 points). They have been disturbed in some ways, and are often less diverse or more isolated from other natural resources in the landscape than Category 2 wetlands.
- Category 4 wetlands have the lowest levels of functions (scores less than 30 points) and are often heavily disturbed. These are wetlands that could be replaced, and in some cases, improved. These wetlands may provide some important ecological functions, and also need to be protected.

The rating categories were largely adopted in LCL Title 17. The categories are intended to be the basis for wetland protection and management to reduce further loss of their value as a resource. Some decisions that can be made based on the rating include the width of buffers needed to protect the wetland from adjacent development, the ratios needed to compensate for impacts to the wetland, and permitted uses in the wetland. The wetland categorization or rating is the basis for determining the size of wetland buffers on the Reservation (LCL Title 17).

As a component of the rating process, a classification key was used to determine whether the wetland was riverine, depressional, slope, lake-fringe, tidal fringe, or tidal flats according to the HGM classification system.

2.4 Method for Updating the Lummi Nation GIS Wetland Inventory/Database

As described in Section 2.1, the updated wetland boundaries were recorded using a mapping grade Trimble GeoXT GPS unit, and downloaded into ArcMap9 GIS software. Once entered into the GIS, any newly identified wetland areas were assigned an identification number based on the Public Land Survey System (i.e., Township, Range, Section). If a newly delineated wetland area essentially

replaced an existing wetland, the original identification number was retained. If a wetland boundary was for a wetland that had not been previously identified, a new number based on the Public Land Survey System was assigned. Other data that were entered into the GIS database for new wetlands included wetland area in acres and hectares, comments about location or other unique features of the wetland, wetland rating/classification, hydrogeomorphic classification, Cowardin classification, the date the wetland was mapped, and watershed name. The Lummi Water Resources Division developed a new Access database during 2007 to better manage the collected information on the Reservation wetlands.

2.5 Method for Quality Assurance/Quality Control

A consulting firm specializing in wetland management (ESA Adolfson) was contracted in 2007 to conduct an independent evaluation of the wetland inventory update program. Professional Wetland Scientists (PWS) from ESA Adolfson evaluated the delineations, rating/classifications, and function assessments conducted by the Lummi Water Resources Planner II (Ginger Lee First, PWS). The Water Resources Planner II had completed Year 1 through Year 3 of the wetland inventory update effort. The Lummi Water Resources Manager selected five representative wetlands for the review. The results of their findings and recommendations for the overall program were summarized in a technical memorandum (Appendix C).

The technical memorandum prepared by ESA Adolfson presents the findings of their review of the five representative wetland areas. The identification numbers of the five representative wetlands are: 38N1E03-07, 38N1E04-02, 38N1E01-18, 38N2E06-01, and 38N2E06-02. In summary, the evaluation findings were:

a) The categorization/ratings determined by ESA Adolfson staff agreed with the categorization/ratings determined by Lummi Water Resources Division (LWRD) staff for all five wetland areas.
b) The function assessments conducted by ESA Adolfson staff were generally in agreement but there were some differences with the function assessments determined by LWRD staff for all five wetland areas.
c) The wetland area boundary determinations by ESA Adolfson staff for two of the wetlands (38N1E03-07 and 38N2E06-02) closely matched the determinations made by the LWRD staff member, the wetland boundary determinations for two of the other wetlands (38N2E06-01 and 38N1E04-02) had minor differences with the LWRD boundary determination, and the boundary determination for one wetland (38N1E01-18) was substantially different.

The new Water Resources Planner I (Frank Lawrence III) has conducted field work with at least five different Professional Wetland Scientists and attended several wetland management related courses to develop his wetland inventory, categorization/rating, and function assessment skills. Ideally, he would always be accompanied in the field with a second wetland biologist so that observed

field conditions could be discussed and a consensus reached on findings. However, resources constraints often limit the availability of a qualified staff person or consultant to provide this second opinion during the course of a wetland evaluation.

3. WETLAND INVENTORY UPDATE RESULTS

The results from Year 4 of the wetland inventory update are summarized below. Detailed field forms for the wetland areas are maintained on file at the Lummi Water Resources Division office. An example of the documentation is included as Appendix B of this synthesis report.

3.1 Results of Wetland Mapping and Boundary Determination

The 14 wetland areas on the Lummi Reservation that were field verified and mapped during Year 4 of the wetland inventory update effort are shown in Figure 3. Detailed maps of each of these wetland areas are presented in Appendix A. Figure 3 and each of the detailed maps presented in Appendix A show the wetland boundary identified as part of the Year 4 inventory update in red, Year 3 of the inventory update in brown, Year 2 of the inventory update in blue, Year 1 of the inventory update in green, and the estimated wetland boundaries from the 1999 inventory in yellow. Where wetland areas are small and/or wetlands were close together, several wetlands are shown on the same map in Appendix A. As summarized in Table 1, a total of approximately 27.8 acres of wetlands were mapped during Year 4. A comparison of the wetland acreage mapped during the first four years of this update effort is summarized in Table 1.

Table 1. Comparison of Wetland Areas Evaluated by Program Year

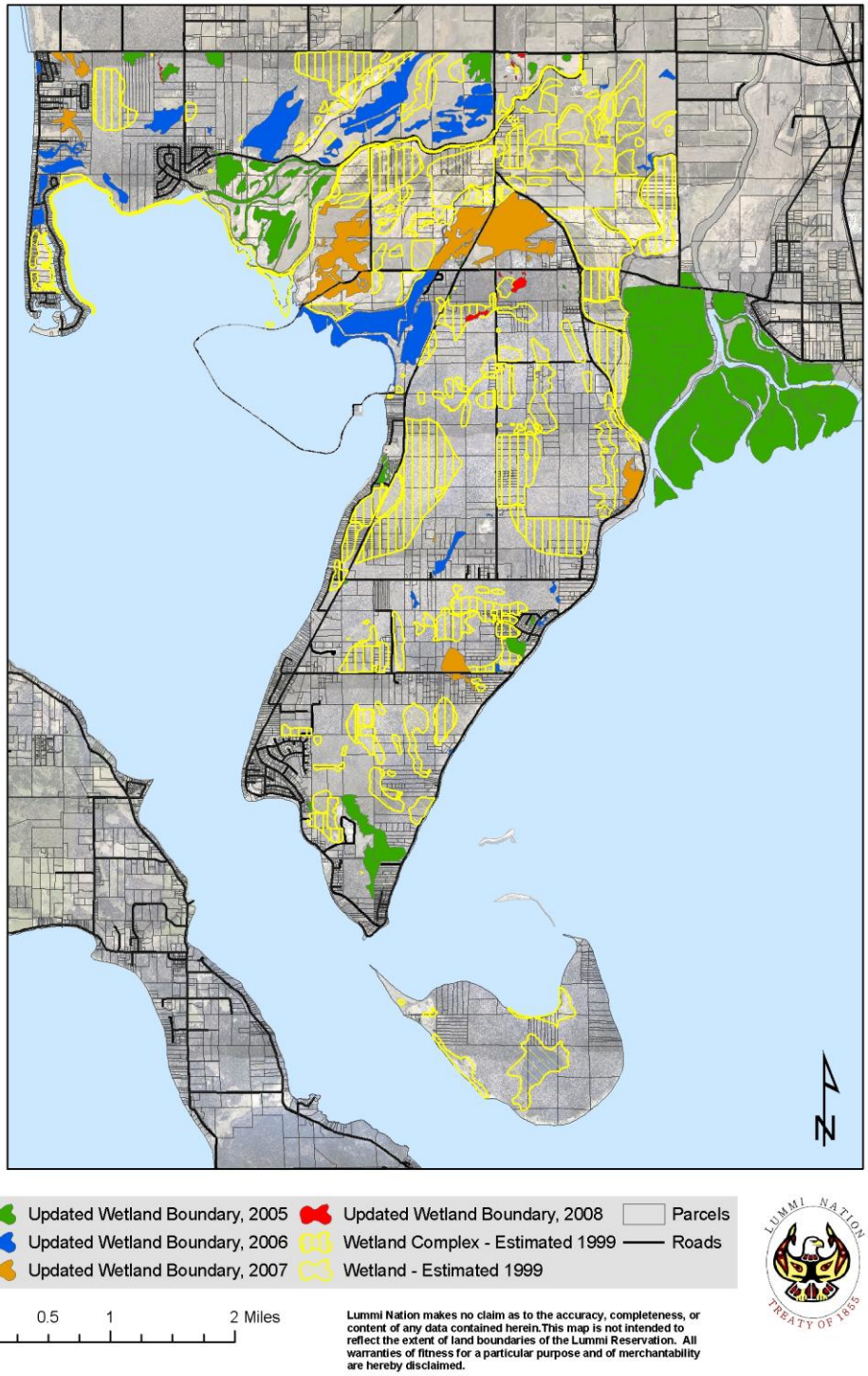
Year	Evaluated Wetland Area (acres)
1	1,104
2	579
3	380
4	28

The reported acreage of mapped wetlands has decreased each year for a number of reasons including:

- The Year 1 Report summarized work that occurred over a period of almost three years and other staff assisted the Water Resources Planner II with the delineation of the Northern Lummi River Distributary Area and the Nooksack River Delta Area.
- The Year 2 Report summarized work that occurred over a one-year period.
- The Year 3 Report summarized work that occurred over a nine-month period with a reduced work week as the Water Resources Planner II worked only 32 hours a week starting in June 2006.
- This Year 4 Report summarizes work that occurred over a 11 month period that included a Quality Assurance/Quality Control effort with ESA Adolfson. A re-verification of some wetland boundaries by Douglass Consulting, and the reorganization of the Lummi Natural Resources

Water Resources Division. This reorganization eliminated the Water Resources Planner II position and created a Water Resources Planner I position. The staff transition included an investment in formal training and practical/field applications with various wetland scientists, which reduced the amount of time available to advance the wetland inventory update effort.

Figure 3 - Updated Wetland Boundaries and Estimated Wetland Locations



As shown in Figure 3 and the higher resolution mapping presented in Appendix A, the boundaries of some of the evaluated wetlands during Year 4 changed to some extent. The wetland mapping and boundary determinations made during Year 4 and the associated wetland sizes compared with the 1999 inventory results are shown in Table 2.

As summarize in Table 2, nine of the wetland areas inventoried and mapped during Year 4 were not identified in the 1999 inventory. The area of these newly identified wetlands was approximately 22.1 acres. However, because a portion of one of the wetland areas mapped as part of the 1999 inventory (38N1E01-21) was an authorized fill for the Lummi Casino Project (Army Corps of Engineers Permit Reference No.: 1999-4-01575) and portions of two other wetland areas (38N1E13-13 and 38N1E26-12) were determined to be considerably smaller than mapped during 1999, the net result from Year 4 is a 9.3 acre reduction in the total acreage of Reservation wetlands relative to the 1999 inventory results. When combined with the results from Year 1, Year 2, and Year 3 (LWRD 2005, LWRD 2006, LWRD 2007), the net change in the total acreage of Reservation wetlands relative to the 1999 inventory has been a decrease of approximately 254.0 acres.

Table 2 – Wetland Size Comparison Results

Wetland ID Number	Watershed Identification	1999 Inventory Wetland Size (Acres)	Inventory Update Wetland Size (Acres)	Difference in Wetland Size (Acres)
37N1E02-10	C	0[1]	0.05	+0.05
38N1E01-05	O	1.50[2]	1.12	-0.38
38N1E01-21	O	17.60[3]	0.18	-17.14[4]
38N1E01-22	O	0[3]	0.28	0[4]
38N1E01-23	L	0[1]	1.10	+1.10
38N1E03-07	P	0[1]	8.40	+8.40
38N1E04-02	Q	0[1]	5.20	+5.20
38N1E12-19	K	0[1]	0.37	+0.37
38N1E12-20	K	0[1]	0.43	+0.43
38N1E12-21	K	0[1]	0.23	+0.23
38N1E12-22	K	0[1]	6.30	+6.30
38N1E13-13	K	17.60[5]	4.10	-13.50
38N1E14-22	I	0[1]	0.01	+0.01
38N1E26-12	H	0.40[6]	0.02	-0.38
	Total	37.10	27.79	-9.31

Notes:
[1] Wetland not identified in 1999 Inventory.
[2] There is a natural breach between Schell Creek (Estaurine Tidal-Fringe) and the depressional area (Riverine Impounding) that connects these AU's(A and B).
[3] Listing the 1999 Inventory wetland size (17.60 acres) one time for the purpose of Table 1. 10.68 acres of the 17.60 acre complex wetland was filled. Army Corps of Engineers Permit Reference: 1999-4-01575 Lummi Indian Business Council
[4] Combined difference (17.14 acres) of updated wetlands (38N1E01-21 and 22) to the 1999 Inventory wetland size.
[5] The 1999 Inventory wetland size is 41.34 acres, due to access considerations 17.60 acres was field verified for this Year 4 update, which resulted in a 13.50 acres difference.
[6] The 1999 Inventory wetland size is 10.96 acres, due to access considerations 0.40 acres was field verified for this Year 4 update, which resulted in a 0.38 acre difference.

3.2 Results of Function Assessment

Pursuant to the recommendations that resulted from the independent program review conducted by ESA Adolfson, wetland function assessments are generally no longer conducted as part of the inventory update effort. Function assessments are now only conducted if a development action is planned that will impact a wetland and a function assessment is required to determine appropriate mitigation for unavoidable wetland impacts. Six function assessments were conducted as part of this Year 4 update.

The Washington Function Assessment Method (WAFAM) was applied to 6 of the 14 wetland Assessment Units (AUs) evaluated during Year 4. Table 3 presents a summary of the function assessment indices for the six AU's that were assessed during Year 4. The general locations of the wetlands that were evaluated are shown in Figure 3, the specific locations are shown on individual maps in Appendix A, and a sample of function assessment worksheet is provided in Appendix B. As demonstrated by the results summarized in Table 3, a particular AU may vary significantly in its relative performance of one function to another. The WAFAM methodology was not designed to lump functions into group scores or to rank functions hierarchically by importance. Therefore, AUs are not compared using an overall index. Rather, the potential performance levels (the index) for each function are compared among the AUs of the same Hydrogeomorphic (HGM) category. Since different models were developed for each subclass, it is not meaningful to compare across categories. That is, riverine flow-through wetlands cannot be reasonably compared to depressional outflow wetlands. Each function index in the WAFAM is essentially a comparison of the assessed wetland to a large pool of reference wetlands.

The WAFAM methodology includes classification for riverine and depressional wetlands into subdivisions including Riverine Flow-through, Riverine Impounding, Depressional Outflow, and Depressional Closed. As summarized in Table 3, four of the evaluated wetlands met the definition of depressional closed wetlands, one met the definition of depressional outflow, and the other met the definition of riverine impounding/estuarine tidal-fringe. During the time of the assessment the Lummi Natural Resources Water Resources Department and ESA Adolfson have not adopted a specific method for assessing the functions of a tidal-fringe wetland.

Table 3: Year 4 Wetland Function Assessment Results

Wetland Name; Assessment Unit ID Number	38N1E01-05-B	38N1E01-21	38N1E01-22	38N1E01-23	38N1E03-07	38N1E04-02
Watershed ID	O	O	O	L	P	Q
Hydrogeomorphic Subclass	RIV	DC	DC	DC	DC	DO
Water Quality Functions						
Removing Sediment	4	10	10	10	10	2
Removing Nutrients	3	10	10	10	8	2
Removing Heavy Metals and Toxic Organics	3	7	7	7	4	2
Water Quantity Functions						
Reducing Peak Flows	8	10	10	10	10	3
Reducing Downstream Erosion	9	10	10	10	10	5
Recharging Ground Water	4	1	1	2	3	2
Habitat Suitability Functions						
General Habitat Suitability	3	1	2	1	6	7
Suitability for Invertabrates	2	0	1	0	6	5
Suitability for Amphibians	2	1	1	1	3	5
Suitability for Anadromous Fish	1	N/A	N/A	N/A	N/A	4
Suitability for Resident Fish	2	N/A	N/A	N/A	N/A	3
Suitability for Wetland Associated Birds	3	3	3	2	4	5
Suitability for Wetland Associated Mammals	5	1	3	4	4	3
Native Plant Richness	2	2	2	1	8	8
Primary Production and Export	5	N/A	N/A	N/A	N/A	4

Notes:

- The numeric index represents the potential level of performance of a function on a scale of 0 to 10. Depressional closed wetlands always score a “10” for removing sediment, reducing peak flows, and reducing downstream erosion because they are closed systems with no outlets and are performing at their maximum because no sediment can leave the wetland. A “NA” indicates for anadromous fish or for production and export indicates that no outlets or flow through streams are present.
- Key for Hydrogeomorphic (HGM) Subclass identification: DC = Depressional Closed, DO Depressional Outflow, RIV = Riverine Impounding, TF = Tidal Fringe

3.3 Results of Wetland Classification

The Washington State Wetland Rating system was applied to 10 (ten) of the 14 (fourteen) evaluated wetland areas. One (38N1E01-05) of the 14 (fourteen) wetland areas has two assessment units (A and B). Four of the 14 (fourteen) wetland areas have not yet received completed ratings/classifications. Douglass Consulting will complete the ratings/classifications for the four assessment units pursuant to a contract between the consulting firm and the Lummi Planning Department. Table 4 presents the ratings for the ten AU's.

None of the wetlands evaluated during Year 4 were rated as Category 1 wetlands. Of the ten completed ratings for the wetland areas for this Year 4 update two were classified as a Category 2 wetland and eight were classified as a Category 3 wetland.

The Washington State Wetland Rating system uses only the highest grouping in the HGM classification (i.e., wetland class).

Table 4 – Wetland Rating and HGM Classification

Wetland ID Number	Watershed Identification	Wetland Rating	HGM Class
37N1E02-10	C	3	Depressional
38N1E01-05[1]	O	2[1]	Riverine
38N1E01-21	O	3	Depressional
38N1E01-22	O	3	Depressional
38N1E01-23	L	2	Depressional
38N1E03-07	P	3	Depressional
38N1E04-02	Q	3	Depressional
38N1E13-13	K	3	Depressional
38N1E14-22	I	3	Depressional
38N1E26-12	H	3	Depressional

[1]This wetland area has two AU's (Riverine and Tidal Fringe). Since the Lummi Natural Resources Water Resources Department and ESA Adolfson have not adopted a specific method for rating a tidal-fringe wetland, the Categorization Based on Special Characteristics, *Hruby, T. 2004. Washington State wetland rating system for Western Washington-Revised. Washington State Department of Ecology Publication # 04-06-025.,* was used for rating this AU. It is not in this Table 3. (see Appendix B)

4. DISCUSSION

Accurate information on the locations, wetland category, and wetland functions is needed in order to effectively manage Reservation wetlands pursuant to the Lummi Nation Water Resources Protection Code (LCL Title 17). Although the 1999 inventory represents an important planning tool and a significant improvement over the previously available information, it has proven to be too general for many planning efforts. Refining the spatial resolution of the wetland mapping and classifying the wetlands into the regulatory categories identified in Title 17 is intended to support efforts to protect these wetland resources and the important ecological, hydrological, and water quality protection functions that they provide. Because of the large number of wetland areas on the Reservation, the effort to refine the spatial resolution of the wetland mapping, to perform function assessments, and to classify the Reservation wetlands is projected to require several years to complete. This report summarizes the results of Year 4 of this inventory update effort.

The overall result of the inventory update effort will be a more accurate GIS data layer and an associated database that contains the classification and other summary information on each wetland on the Reservation. Hard copies of field notes (e.g., wetland rating worksheets, function assessment work sheets, location maps) are maintained in binders in the Lummi Water Resources Division office. Until the update effort is completed, the GIS data layer and associated database will be a work in progress. The current version of the Lummi Reservation Wetland Map is shown in Figure 4. Figure 4 shows the information in Figure 3 except that the 1999 wetland locations that were revised during Year 1 through Year 4 of this update effort have been modified accordingly. Figure 4 is intended to reflect the best available information on Reservation wetlands.

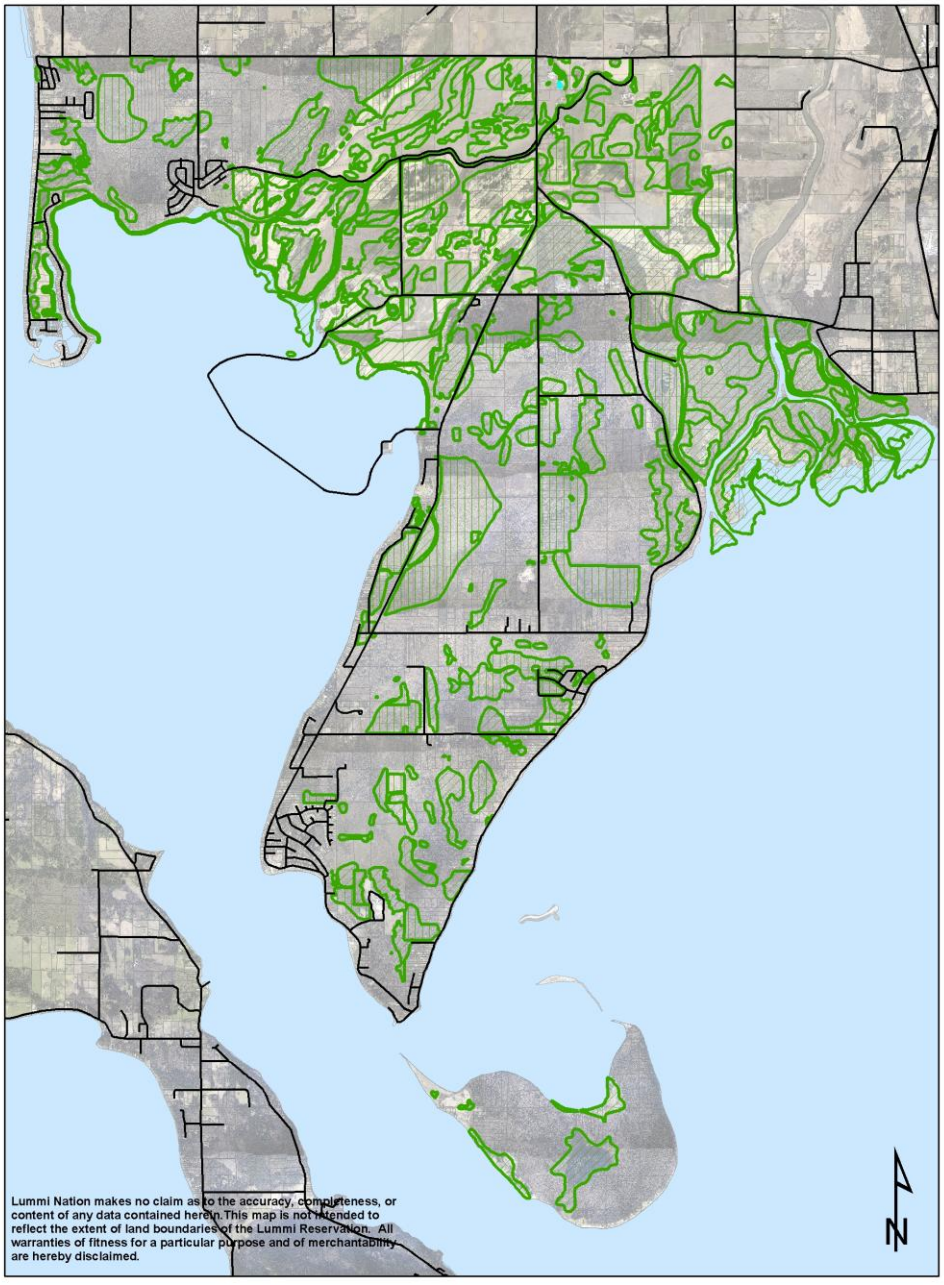
As described previously, Year 4 of this inventory update resulted in revising the locations and extent of 14 wetlands, collecting additional information on the functions of six wetlands and classifying ten wetlands into one of four categories. Based on the changes to the spatial locations and the utility of the collected information on wetland function and category, the inventory update should continue until it is completed.

Because of the amount of time and resources required to complete the inventory update the approach was modified for Year 4 to eliminate the time consuming wetland function assessment element of the inventory update unless the wetland was about to be impacted by a proposed development project. The modified approach adopted for Year 4 is to retain the effort to improve the spatial resolution of the Reservation wetland inventory and the effort to classify/rate the Reservation wetlands into one of four categories to support the implementation of Title 17 and the associated determination of the appropriate buffer width. However, wetland function assessments will be deferred until a development action is planned that will impact a wetland and a function assessment is

required to determine appropriate mitigation for unavoidable wetland impacts. The modification is anticipated to allow more of the Reservation wetlands to be visited during a year and to accelerate the completion of the inventory update.

Future phases of this study will include estuarine wetlands, which are Category 1 wetlands if they are relatively undisturbed and are larger than one acre. Estuarine wetlands are not included in the classes of wetlands that are covered by the WAFAM method at this time, so a different method will need to be used, or the evaluation of these wetlands delayed until the methodology is developed.

Figure 4 - Best Available Wetland Inventory Map (November 2008)



5. REFERENCES

Brinson, M.M. 1993. A Hydrogeomorphic Classification for Wetlands. U.S. Army Corps of Engineers Waterways Experiment Station, Vicksburg, MS. Wetlands Research Program Technical Report WRP-DE-4.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. U.S. Government Printing Office, Washington, D. C. Publication No. FWS/OBS-79/31.

Harper, K. 1999. Comprehensive Wetland Inventory of the Lummi Reservation. Sheldon and Associates, Inc. Seattle Washington.

Hruby, T, T. Granger, K. Brunner, S. Cooke, K. Dublanica, R. Gersib, L. Reinelt, K. Richter, D. Sheldon, E. Teachout, A. Wald, and F. Weinmann. July 1999. Methods for Assessing Wetland Functions Volume 1: Riverine and Depressional Wetlands in the Lowlands of Western Washington. WA State Department of Ecology Publication #99-115. Olympia, Washington.

Hruby, T. 2004. Washington State wetland rating system for Western Washington – Revised. Washington State Department of Ecology Publication #04-06-025.

Lummi Water Resources Division (LWRD). 1997. Lummi Nation Wellhead Protection Program --Phase I. Prepared for Lummi Indian Business Council. Lummi Reservation, Washington. November.

Lummi Water Resources Division (LWRD). 1998a. Lummi Reservation Storm Water Management Program Technical Background Document. Prepared for Lummi Indian Business Council. Lummi Reservation, Washington. December.

Lummi Water Resources Division (LWRD). 1998b. Lummi Nation Wellhead Protection Program --Phase II. Prepared for Lummi Indian Business Council. Lummi Reservation, Washington.

Lummi Water Resources Division (LWRD). 2000. Lummi Indian Reservation Wetland Management Program. Prepared for Lummi Indian Business Council. Lummi Reservation, Washington. March.

Lummi Water Resources Division (LWRD). 2001. Lummi Nation Non-Point Source Assessment Report. Prepared for Lummi Indian Business Council. Lummi Reservation, Washington. December.

Lummi Water Resources Division (LWRD). 2002. Lummi Nation Non-Point Source Management Program. Prepared for Lummi Indian Business Council. Lummi Reservation, Washington. January.

Lummi Water Resources Division (LWRD). 2005. Lummi Nation Wetland Inventory Update Year 1 Synthesis Report. Prepared for Lummi Indian Business Council. Lummi Reservation, Washington. December.

Lummi Water Resources Division (LWRD). 2006. Lummi Nation Wetland Inventory Update Year 2 Synthesis Report. Prepared for Lummi Indian Business Council. Lummi Reservation, Washington. December.

Lummi Water Resources Division (LWRD). 2007. Lummi Nation Wetland Inventory Update Year 3 Synthesis Report. Prepared for Lummi Indian Business Council. Lummi Reservation, Washington. December.

Lummi Water Resources Division (LWRD). 2008. Water Quality Standards for Surface Waters of the Lummi Indian Reservation. Prepared for Lummi Indian Business Council. Lummi Reservation, Washington. September.

U.S. Army Corps of Engineers (COE). 1987. "Corps of Engineers Wetlands Delineation Manual," Technical Report Y-87-1, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

U.S. Department of Agriculture-Soil Conservation Service (USDA). 1992. Soil Survey of Whatcom County Area, Washington.

U.S. Fish and Wildlife Service (USFWS). 1987. National Wetlands Inventory. Washington, D.C.

Washington State Department of Ecology. (Ecology) 1991. Washington State Wetlands Rating System for Western Washington. Olympia, WA Publ. #91-57

APPENDIX A – INDIVIDUAL WETLAND MAPS

APPENDIX B – SAMPLE OF FUNCTION ASSESSMENT AND WETLAND RATING WORKSHEETS

APPENDIX C – QUALITY ASSURANCE/QUALITY CONTROL TECHNICAL MEMORANDUM BY ESA ADOLFSON